Winter 2-1901

Volume 10 - Issue 5 - February, 1901

Rose Technic Staff
Rose-Hulman Institute of Technology

THE ROSE TECHNIC.

VOL. X. TERRE HAUTE, IND., FEBRUARY, 1901. NO. 5

THE TECHNIC.

TERMS:
One Year, $1.00. Single Copy, 15 cents.
Issued Monthly at the Rose Polytechnic Institute.
Entered at the Post Office, Terre Haute, Indiana, as second-class mail matter.

A FEATURE of the policy of the Institute this year, and an unwelcome one, we believe, to the majority of students, has been the discouragement of the class rivalries, which have formed hitherto so essential a part of the student interest. THE TECHNIC believes, from investigation, that the majority of the Student Body regret that the Faculty feel as they do in this matter, and we feel that a statement of this should be made. We believe, at the same time, that the Student Body unites with THE TECHNIC in a strong regard for and confidence in the Faculty of their school. Before this was written the President of the Institute was informed of the intention to express these opinions. With great courtesy Dr. Mees explained his reasons for his peremptory instructions with regard to banquet interference. His ideas, which have a great deal of truth in them, even as we see the matter, are as follows:

He does not oppose rivalry of a certain sort, but names three evils of the present system which are particularly worth noticing, and which he regards as sufficient to condemn it. First. The student's object in coming to school is to work, and the course as planned requires most of his time. Diversions produced by class competition take away largely from his time and the concentration of his energies on his work. Second. Many students take no pleasure in such skirmishes, and are forced to waste their time by engaging in them. Third. These rivalries are likely to grow to such an extent that personal injury may result, or on the other hand, that such unfavorable impression or comment may be aroused by the action of a class or its members, that the school's reputation may be injured.

And it is true enough that there is *risk* in all these things. It is hard indeed to be sure that a class which has behind it precedent authorizing the breaking up of a rival's banquet, will stop at what is within sensible bounds. There *is* danger that all boyish pranks may be disastrous. But, admitting these facts, there seem to be positive virtues that outweigh all possible ills.

The person whose arteries have never been filled with boyish blood, and who has never been stimulated by boyish energy to the animated exercise of every mental and bodily faculty he possesses, cannot become a well-rounded man. His education is incomplete. And he is bound to miss something if he quits being a boy before he is ready to be a man. We should say that for his complete education in school a student ought to take considerably more time from his routine school work than is ever asked of him by class obligations.

As to the risk, we can never do anything that is worth doing, without risk. The boy who refuses to do anything except that which involves no possibility of disaster, is hardly likely to be famous. And as to the boy who has no interest in class affairs, his species is happily not in the majority. But as his chief claim to our attention is that he is not strong enough to stand up for his opinions, he needs training, and we do not know of anything better than such competition, as a teacher of self-control and self-reliance.

We believe that there are few Alumni who do not appreciate to a very full extent the memories of the excitement, the responsibility and the fun of the "scraps" of their college years. The dissolution of such customs as these will deprive the man who will be an Alumnus some day of one of the richest bequests of a college course.

Moderation in these things is painfully necessary, and the strongest injunctions that can be put into words should be used as influence in the right direction, but we hope sincerely that no distrust of the young man's self-control will deprive him of any important part of his college education.

We believe that few men of the Institute will criticise the action of the Faculty in enforcing a rule once made, or will recognize in the recent action of the Faculty anything but a sincere desire to better things, but we do hope, as guided by our own—perhaps faulty—feelings on the sub ject, that this years' events will not tend to destroy the precedent of good-natured rivalry between classes.

THE TECHNIC is indebted to the Duff Patents Co., of Pittsburgh, and R. D. Wood & Co., of Philadelphia, for the cuts of the Duff and of the Taylor gas producers, which appear in the article on "Producer Gas and Gas Producers."

THE death of the father of Mr. McCormick, after an illness of many months, is noticed elsewhere in this issue. THE TECHNIC desires to express, both to Mr. McCormick and his brother, its heartfelt sympathy.

AS announced in the last issue, the first of the supplements appears with this number of THE TECHNIC. It is hoped that these may be continued monthly, and care will be taken that the different directions of engineering work shall all be represented in the series. For convenience, in case it be desired to separate them from the rest of the book, the pages on which the supplements are printed will be independent of the other contents of the issue. Suggestions as to desirable subjects for future numbers will be very welcome. We are indebted to Prof. Howe for this month's supplement.

AS promised in the October number, the Editor has offered his resignation to the Board, his term of office to expire with this number. The Board has asked that he continue in office, and has been kind enough to offer especial help in the management of THE TECHNIC on account of the press of Senior duties.

Editor of THE ROSE TECHNIC:

I SHOULD like to call attention to an error occurring on Page 91 of your January issue, in my article on Boiler Explosions. In calculating the heat which would be set free by the sudden reduction of pressure in a steam boiler, I inadvertently used the *total heat* of steam at the two pressures considered, instead of the *heat of the liquid*, as should have been done. The sentence should have read thus: "The heat which will be set free instantly will be $8255 \times (319.8 - 258.7) = 504,380$ heat units, sufficient to generate 541 pounds of steam at 20 pounds pressure, which would fill a space 62 times as large as the steam space of the boiler."

F. C. WAGNER.

The Value of Difficulties.

BY J. B. PEDDLE.

"Sweet are the uses of adversity,
Which, like the toad, ugly and venuous,
Wears yet a precious jewel in his head"

I WANT to take this as my text for a little talk about difficulties, and to show, if I can, that they are not to be looked upon as evils, but in some degree as blessings,—disguised blessings if you will, but still blessings.

It is a favorite theory of mine that there are few things we really learn much about except through practical experience. Nearly everything we do is, to a certain extent, experimental, and while we may comprehend or think we comprehend all the conditions of a new undertaking and have them laid down by hard and fast rules, there is one thing, our personal equation, which can never be accurately predicted and which must in every case be an unknown factor until it has been tested on this or similar work.

Thoreau must have had some such idea in mind when he wrote "Practically the old have no very important advice to give to the young. * * * * I have lived some thirty years on this planet and have yet to hear the first syllable of valuable or even earnest advice from my seniors. They have told me nothing and probably cannot tell me anything to the purpose. Here is life, an experiment to a great extent untried by me; but it does not avail me that they have tried it. If I have any experience which I think valuable, I am sure to think that this my Mentors said nothing about."

And allowing for Thoreau's habitually exaggerated style, I think that there is much truth in what he says.

Practical experience is necessary not only to determine our own mental attitude towards a subject but to give us the requisite mental strength and skill to handle it properly, and this is quite as necessary as are skill and strength for athletic exercises.

A man may have ever so good an acquaintance with the geometrical propositions demonstrated in his book, but unless he has had some experience in solving original exercises the chances are that he will fail utterly when he tries to work out a new problem for himself.

I might put in my time in the class room for a year lecturing to you on the proper methods of making free-hand drawings, and unless you had had some chance for practice in the meanwhile you would be as little able to make a respectable sketch at the end of this time as you were at the begining.

In your language studies you may be ever so perfect on the grammar but still be unable to speak correctly and fluently if you are without practice in speaking.

The same thing might be aptly illustrated in the domain of morals by the proverbial waywardness of the minister's son, which, if it have any foundation in fact, might be charged to an excess of moral precept with too few opportunities for its practice in the way of temptation. There is a popular belief that temptation should be eliminated as far as possible from a young man's experiences, but I cannot think that this is right. You do not make a man a good man by forcibly preventing him from doing wrong. His character should be judged not so much by what he has done as by what he would do if he had a chance. Temptation as a means of grace has not found much favor with our religious societies, but I believe that a moderate amount of it has a distinct tonic value, and is an essential part of any training for self control.

So it is in the matter of overcoming difficulties. A man must have had some practical experience in this to do it successfully and I believe this experience to be an essential part of the education of any successful man. No amount of theorizing or preaching is going to help him much when he comes face to face with the real thing. The conditions will seem altogether different from anything he had imagined; some essential elements of the theoretical case will be omitted and some which he had never dreamed of are put in their places, and unless he has developed a spirit of resourcefulness to meet these new and unexpected conditions he is likely to have trouble when left to himself.

It is not a little remarkable, and at first sight incomprehensible, that so many prominent men in every walk of life have risen from poor surroundings, but these men themselves will tell you that the very hardships they endured and the necessity they were under for overcoming them gave them a training of the greatest value. In fact so far from thinking that the rich boy starts out in life with the advantage all on his side, I am not sure that the chances are not in favor of his poorer companion, in so far at least as making a man is concerned, and I think that the long list of worthless sons of rich men of whom we all know more or less goes far towards sustaining my theory.

To bring this matter a little nearer home let us see what bearing it has upon our school work.

There have been in the past few years a great many new theories advanced as to the proper methods of carrying on educational work. Among others, attempts have been made to develop the Kindergarten idea which has been so successful with small children, and to apply it to our higher schools.

As I understand it the student is to be led along the path of least resistance, and great care is exercised that he makes no conscious effort to acquire knowledge. He absorbs it all by the so-called "natural" method.

I myself believe that for older students this is thoroughly bad, for outside of the fact (which has been proved) that the knowledge so gained is small, it makes a boy a shirk. Instead of learning how to overcome his difficulties he learns how to avoid them. He does things because he wants to and not because he ought, and the important training in a sense of duty is entirely lacking. When he gets away from school and has to shift for himself, this policy of evasion is not possible, for no employer will keep such a man at any price.

This is the kind of man who is always complaining that luck is against him. He does not know how to meet even the smallest difficulties and gives up at their first appearance.

I believe that a study should not be made too easy, and that a student who has his own best interests at heart will do his utmost to overcome his difficulties alone, and that not until he has made an honest effort to do this and failed will he ask for help.

The drawing teacher from whom I learned most was a man who made a point of showing us as little as he could in the way of actual drawing. His criticisms were unsparing but he made us work out our own methods. The treatment was certainly heroic and might not work well in every case, but I am certain that the training that I got in that class in thinking for myself has been invaluable.

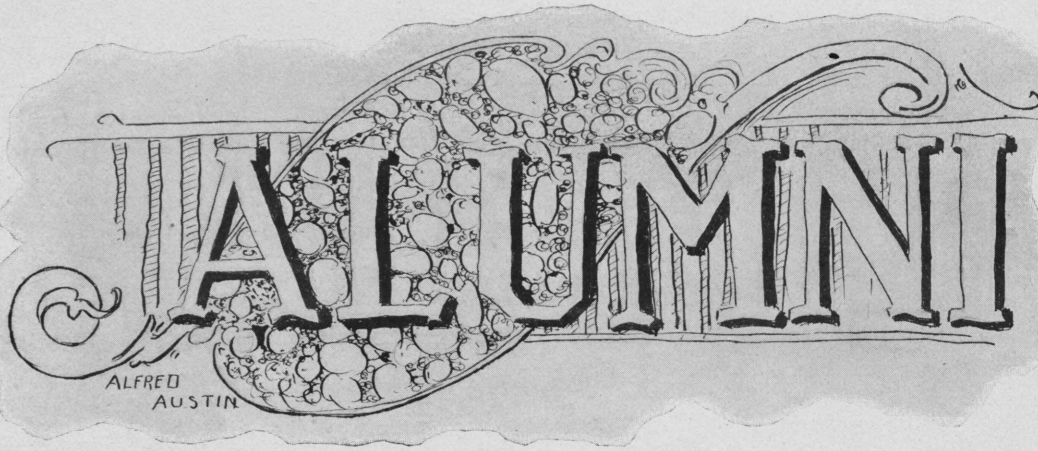
I think it is not a bad idea to occasionally hunt up a few difficulties, if things are going too smoothly with you, just for the sake of practice. Try to puzzle out the whys and wherefores of any strange or unfamiliar subject for yourself and without asking questions or at least before asking them. You are likely to find such a habit of great service later on. The average employer when he gives you a new piece of work to do does not want to be bothered with telling you how to do it. He could probably do it himself in less time than it takes to explain it to you, and he will not begrudge you a little extra time of your own on the work if you can do it without his help.

I do not mean that I approve of rash attempts to do work with whose nature or difficulties you are unfamiliar but in nine cases out of ten you will find the battle half won if you enter upon it with a determination to succeed if it be in your power, and often a closer inspection will show that the difficulties are more imaginary than real.

I have found it an excellent practice in looking over an unfamiliar machine to see if I would have solved the problems connected with it in the same way as did the designer, and to try to find out for myself the reasons for any departure from my ideas or from established custom. I like to do this before asking any questions and then compare the answers I get with my own conclusions. It is surprising to one who has never tried it how much may be done by a little deductive reasoning and what a flood of light is sometimes let in upon an obscure subject.

But outside of all these things I think that the most important result which follows from this habit of overcoming rather than avoiding difficulties is the feeling of self-reliance which it gives, and this is of the greatest value to a young engineer.

It is an old saying that nothing succeeds like success, and it is certainly true that a successful encounter with small difficulties will strengthen and encourage a man for larger undertakings as will nothing else.



Long Distance Telephony.

By J. HENRY LENDI, '97.
WITH KELLOGG SWITCHBOARD AND SUPPLY CO., CHICAGO.

THE transmission of telephonic currents presents the problem of electric transmission of energy in its most complicated form. This becomes apparent when we consider the difference between the transmission of energy merely as energy, and as articulate speed.

It is not of great importance in the transmission of energy as energy whether the exact wave form is preserved or not, whereas in the transmission of articulate speech it is essential that at least the principal harmonic constituents of a tone be transmitted, and of vital importance that the various frequencies constituting any particular tone be transmitted with a loss proportional to their respective amplitude, if we wish to preserve the quality of the original tone.

Again, in power transmission by means of alternating currents of electricity we can calculate our line for a particular frequency and e. m. f. for a maximum efficiency once for all, while a telephone line is called upon to transmit frequencies from a hundred to five or six thousand vibrations per second and of potentials sometimes so small that only a quite sensitive galvanometer will detect them.

In spite of all this, long distance telephony is an accomplished fact, and I think that I am safe in saying that if the proper precautions are observed it is possible to belt the earth.

Whether this would be a commercial possibility would depend altogether whether or not the telephone traffic between the two points connected would warrant the expense of such a line.

The only way of satisfactorily treating this problem is experimentally, guided by mathematics, amending the mathematics in accordance to the results of your experiment and proceeding as before. This method of proceedure will ultimately approach indefinitely near a perfect telephone line.

It may seem curious to say that no improvement in the telephone apparatus proper is likely to improve the service in long distance connections, yet the truth of this becomes evident when we consider the extreme sensitiveness of the receiver to small changes of current. In fact, it is almost impossible to conceive of any improvement that can be made on the receiver and at the same time keep it in a commercial form.

As to the transmitter, while there is considerable room for improvement in the way of getting a greater variation of current for a given impulse on the transmitter, yet if the line conditions are such as to distort the articulation, such an improvement in the transmitter, which would only increase the loudness, would be of little importance. It is poor policy to sacrifice quality of articulation for loudness, as the ear can define remarkably weak tones so long as the articulation is unimpaired. However, one improvement in the transmitter was made at the advent of long distance telephony, that will be mentioned at the proper time.

It may be well to mention another long distance telephone system that is yet to be invented, and that is the idea of regenerating the telepnone currents at intervals along the line, that is, a sort of telephone relay scheme.

At present the telephone relay is in about the same state of perfection as the rotary steam engine, and bids fair to remain so for some time. The difficulty of this problem may be appreciated when it is remembered that one million dollars in cash is offered for a satisfactorily operating telephone relay.

The electrical properties of a telephone line that we may expect to affect the transmission of articulate speech electrically are the resistance, leakage, distributed inductance and distributed capacity.

So far as resistance alone is concerned, we may expect little trouble, since the ohmic resistance simply cuts down the volume of the current and in no case affects the quality. Of course, where the distance is very great the amount of current transmitted may be so small as to give poor service. The remedy that is suggested in that case is simply to increase the diameter of the line wire. This, however, introduces another difficulty—distribution of current in the cross section of a conductor, or stating this more properly, the increasing *effective* section for carrying currents of high frequency as the surface of the conductor is approached.

The skin effect increases with the frequency and the diameter of the wire, and for the same rate of increase in resistance, on account of this effect the product of the square of the diameter of the wire and the frequency is constant.

It will be seen from this the proposal for decreasing resistance is to some extent made impracticable from an economical point of view, as an increased area of section of wire does not give a proportional increase in conductivity. It may be suggested that instead of using cylindrical wire giving the least surface for a given volume, to use a flat ribbon. Such a form of conductor would have several other advantages.

The second property, leakage between the line wires, is generally so slight that it may be neglected. Only in extremely wet weather does it affect the transmission, and even in that case, while it weakens the current at the receiving end, it is at the same time beneficial in that it improves the articulation by reducing the static capacity of the line, and of all things to be gotten rid of or reduced in a telephone line capacity is most important.

We next have the inductance, or self-induction. Inductance is due to the field of force genated about a conductor carrying a current. A continued alternating current must therefore constantly overcome and reverse its own field of force.

The magnitude of the inductance depends on the distance between the outgoing and incoming wire, and the diameter of the wire, as is shown in the following formula for the case of parallel wires:

$$L = \mu/2 \times 2 \text{ Log } \frac{d}{r} \text{ in cms. per sec.}$$

Where μ=inductivity of the wire
r=radius of wire in centimeters
d=distance between the wires in centimeters.

The effect of inductance in a telephone line is to retard the current and obliterate the higher harmonics that give the property of quality to sound. Like leakage, a little inductance, if it be of such magnitude that with the capacity it makes the lines resonant, is a good thing. An idea of the magnitude of this quantity may be gained from the New York-Chicago line, which is built of No. 8 B. & S. G. copper wire and has an inductance of .004 henrys per mile.

The distributed capacity of a line is the property that presents the greatest difficulty in telephony over great distances, and particularly to submarine telephony. In fact, submarine telephony is on this account yet an unsolved problem.

The effect of distributed capacity is that it causes varying rates of decay of amplitude among the various frequeneies transmitted, and also causes waves of higher frequencies to be propagated with a greater velocity than those of a lower frequency. It must not be understood that distributed capacity is any more detrimental to a telephone line than inductance. It is only from the fact that it is so large and so difficult to overcome by mechanical or constructional means that makes it the predominating difficulty in long distance telephony.

The capacity of the New York-Chicago line is .009 microfarads per mile.

It was at this point my object to treat this subject mathematically, but after having worked it out completely I considered it a little too tedious to reproduce here. So what follows is simply a review of some of the more important results arrived at in the calculations.

The first interesting property that comes up is the displacement of phase between two vibrations of different frequencies.

For instance, in the New York-Chicago line a distance of 900 miles a tone of 160 vibrations per second—approximately the fundamental tone of an average male voice—has a wave length of 1060 miles, while the first prominent overtone—320 vibrations per second—has a wave length of 585 miles.

That is, the fundamental and its first prominent overtone reach the distant end 90° apart. Now, if our organs of hearing were so constituted as to appreciate difference of phase between the two vibrations, there would not be any such thing as long or short distance telephony.

As a matter of fact, the ear is a sort of harmonic analiser, separating the harmonic constituents of a sound, each making its own impression independent of the other. In order to satisfy yourselves on this point—and I wish to emphasize it particularly since several writers have brought it forward as a limitation to long distance telephony—set up two tuning forks of different pitches and strike them at random several times. The ear will appreciate the same sensation in every case, no matter how many trials you make, yet the probability of starting both waves at the same phase difference in the several trials is exceedingly remote. There is, however, a possibility of trouble in the different rates of propagation of long and short waves, for instance, the pitch 160 is propagated with a velocity of $160\times1060=170,000$ miles per second, while the pitch 320 travels $320\times585=186,000$ miles per second, and therefore if both pitches start simultaneously at Chicago the higher will beat the lower $\frac{1}{1000}$ of a second before they reach New York.

Such a fault, though, would not be serious, as the low tone would only slightly overlap the one that started immediately after at the transmitting station, and is corrected by the habit that one soon acquires when he realizes that he is speaking over a thousand miles or so—to speak slowly, so that successive tones do not follow each other so rapidly, and therefore that the belated wave will not modify the wave following it.

Another point brought forward as a limitation to long distance telephony, and one that is more tenable than any other, is the varying rates of decay among the different wave lengths.

A calculation shows that a wave of frequency 160 experiences the same decay of amplitude in going a certain distance as a frequency of 640 experiences in going one-half that distance.

A calculation for the New York-Chicago line shows that if we represent the amplitude of the current for a period of 160 alternations per second will be 93, while the fifth octave above the fundamental will be 85 at the distant end of the line.

Such a state of affairs would evidently seriously affect the quality of transmission were it not for a very important property of the transmitting device of giving a greater prominence to high pitches and therefore compensating for the subsequent loss on the line.

It therefore appears that the third limitation is removed, and it therefore remains only to show along what lines improvements can be made on the present long distance lines, and also what is necessary to make possible submarine telephony.

These propositions are : For a given impulse on the transmitter, a given impulse and resistance the current will be a maximum for that value of the inductance which will make the line resonant for the average telephonic frequency, and all limitations that existed before will disappear as though they had never exsisted. This fact, together with the one that a line resonant to one telephonic frequency is very approximately resonant to all telephonic frequencies, seems very promising to the future of telephony. Of course, the actual carrying out of the principles may be quite difficult.

Methods for putting existing long distance lines in a resonant state have been suggested from time to time, but no attempt has been made to carry out these suggestions, because there was so little, data both experimental and theoretical, at hand in regard to long electric waves. Nothing was done until the experiments of Prof. M. I. Pupin, of Columbia College, on artificial telephone lines, and now that definite results have been secured in these experiments, steps are being taken to apply the facts thus discovered to the present long distance lines.

Both lack of time and further data forbid my going into the details of the latter part of this article. The lack of time is due to the very fact that I am trying to overcome the other deficiency, as I am at present engaged in designing an artificial long distance line approximating as nearly as possible the New York-Chicago line, and hope to be able to make the facts learned therefrom the subject of a less general discussion of this subject than the present one.

Should the reader desire to learn something regarding the action of the telephone lines, he cannot do better than to read Prof. Pupin's paper on long electrical waves in Vol. XXI, No. 3, of the Transactions of the American Inst. of Electric Engineers.

ALUMNI NOTES.

The following announcement has been indirectly received:

Mr. and Mrs. Henry C. Graham announce the marriage of their daughter Georgia Ann, to Austin Van Hoesen Mory, Wednesday, December twenty-sixth, Nineteen Hundred, Manchester, Iowa.

Sidney Kidder, '00, is on the staff of T. L. Condron, '90, Western Representative of the Pittsburgh Testing Laboratory, offices in the Monadnock Building, Chicago.

The Class of '92 is about to send out a class letter, emanating from the Class Secretary, S. B. Tinsley, at Louisville.

W. A. Layman, '92, will deliver a paper before the engineering students of the University of Missouri in their spring lecture course.

Producer Gas and Gas Producers.

By G. H. CLAY, '01.

THE impending failure of the natural gas supply has turned the attention of the manufacturers of the gas belt toward securing a suitable substitute. Not only the present users of natural gas, but many other lines of industry are beginning to appreciate the advantages of gaseous fuel. The requisites for a suitable substitute for natural gas are reliability of source and cheapness. The almost limitless beds of coal supply the proper source, and the conversion of this coal into producer gas is the most satisfactory method of using its heat. This gas is more especially adapted for use in steel works, rolling mills, smelting furnaces, glass works and chemical works. Later developments point to its use in boiler firing and in gas engines.

The producer gas is in reality a combination of the water gas and air gas processes. When an insufficient supply of air is passed through a bed of incandescent coke, the carbon combines with oxygen to form, first, carbon dioxide, which is reduced by the hot coke above to form carbon monoxide, CO. The nitrogen of the air passes through unchanged and the product contains 65.3% nitrogen and 34.7% carbon monoxide. The product is a weak combustible gas, and the process is extremely wasteful owing to the evolution of heat in the furnace. To secure greater economy the gas must be enriched and the evolution of heat in the furnace must be reduced to the lowest possible point. Both objects are accomplished by the use of a steam blast in connection with the air draught ; the steam is decomposed by the action of the hot coke, forming water-gas, thus :

$$H_2O+C=2H+CO$$
$$2H_2O+3C=2CO+CH_4$$

As this is an endothermic reaction it uses up the excessive heat due to the partial combustion of the coke. When coal is substituted there is an additional advantage due to the distillation of the volatible combustible matter in the coal. However, the nitrogen still remains in quantities averaging 55%, and this makes producer gas the weakest of all useful gases. The relative energies of different gases, as well as the compositions, are given in the following table :

Average Volumetric Analysis.	Natural Gas.	Coal Gas.	Water Gas	Producer Gas Anthra.	Producer Gas Bitum.
CO	0.50	6.0	45.0	27.0	27.0
H	2 17	46.0	45.0	12.0	12,0
CH_4	92.6	40.0	2.0	1 2	2 5
C_2H_4	0.31	4 0	. .	. .	0.4
CO_2	0.26	0.5	4 0	2.5	2.5
N	2.61	1.5	2,0	57.0	55 3
O	0.34	0.5	0.5	0.3	0.3
Vapor	. .	1.5	1 5	. .	. .
Pounds in 1000 cu. ft.	45.6	32.0	45.6	65.6	65.9
H. U. in 1000 cu. ft	1,100,000	735,000	322,000	137.455	156,917

The values in the bottom line show the relative energies of the gases. Ordinary illuminating gas has almost five times, and natural gas has seven times, the energy of producer gas.

At the same time producer gas is the cheapest artificial fuel gas per unit of heat. This is due to the high efficiency of the process, more than 85% of the energy of the coal being theoretically available in the gas.

The loss of heat may occur either in undue evolution of carbon dioxide, or from the producer itself, in the following ways:

(1) Carried away by the gas.

(2) Radiation.

(3) Carried out by the ashes.

(4) Used in distilling the coal.

As it is necessary to keep up the temperature of the producer to the point at which combustion can take place, the greater the amount of heat lost the smaller the quantity of steam which can be used. When carbon monoxide is being produced the evolution of heat in the producer is about one-third that which the solid carbon would give:

1 g C burned to CO_2=8080 cal.

1 g C burned (CO to CO_2)=5677 cal.

1 g C burned to CO=2403 cal.

But when carbon dioxide is produced the heat loss becomes much greater; the chief combustible constituent decreases, and the nitrogen increases in amount. Carbon dioxide occupies the same volume as a quantity of carbon monoxide, but, as it contains twice the amount of oxygen, the production adds twice the amount of nitrogen to the gas. It is very important, therefore, to prevent the formation of carbon dioxide.

The heat carried away by the gas is considerable, but the amounts of heat lost by radiation and in the ash are comparatively small. The heat used in distilling the coal is negligible in the comparison between solid and gaseous fuel.

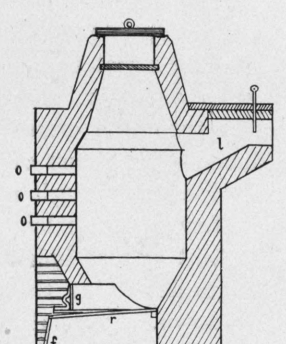
A gas producer is, perhaps, the simplest of all metallurgical furnaces. All that is required is a vessel that will hold a bed of hot fuel and a means of forcing or drawing a current of air, or steam and air, through. The first types of producers were mostly designed to use cheap fuel, such as saw-dust, turf, refuse lignite and small slack coal.

An interesting specimen of the early producers is the Bischof, which was in use prior to 1850. It was intended for use without the blast of air. The cylindrical body, as shown in the illustration, was 5 feet in diameter and 5½ feet high. The fuel rested on a grate, below which was an ash-pit, sealed by the slab, f. The fuel was added by means of a hopper, and the natural draught was admitted through holes in the slab, f. The test holes in the walls of the cylinder enabled the operator to determine the condition of the fire. The lower aperture should show light red, the middle one less intense, and the upper one should show no signs of combustion. The apertures were kept closed when not in use.

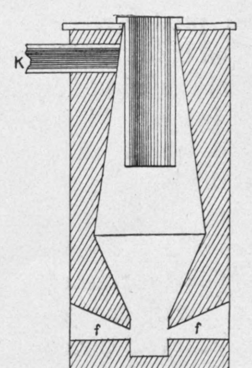
The Ebelmen producer was proportioned similar to a blast-furnace, and was intended to be used with a blast of air. It was 10 feet high from hearth to throat and 3 ft. 4 in. across the widest part of the body. The feed pipe was kept filled with fuel, small charcoal being generally used. The blast was introduced at f, and the gas passed out at k. On account of the fusion of the ash to the sides of the pit it became necessary to add about 1½% of the blast furnace slag and clay.

Numerous designs followed, most of them being for special purposes, and having special features to suit the case.

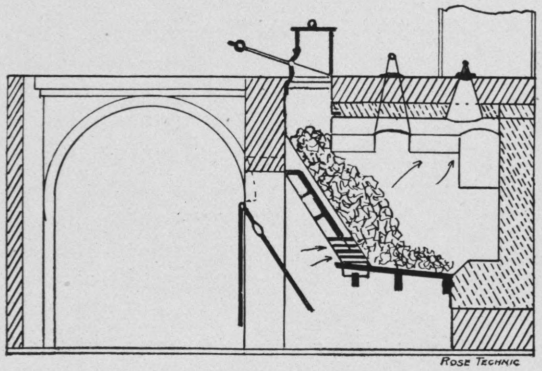
The Siemens furnace, patented in 1857, was for a long time the most satisfactory producer for general purposes, and it is still used consider-



BISCHOF PRODUCER.



EBELMEN PRODUCER.



SIEMENS' (OLD STYLE) PRODUCER.

ably. In it, the fuel works down from the hopper over a step grate, and finally falls into the ash-pit below. A slow draught has to be used, as the thin bed of fuel renders rapid combustion unsuccessful. The draught is obtained by cooling the gas as it leaves the producer, thus increasing its density and causing a downward draught toward the furnace. The cooling, however, condensed the hydrocarbons, not only reducing the energy of the gas, but causing annoyance from deposits of tar, etc.

The ordinary gas producer now on the market consists of a cylindrical shell lined with fire brick and covered either with a cast-iron plate or a fire brick dome. Provisions are made for admitting the coal at the top and removing the ashes at the bottom. Pipes connect with an opening near the top of the producer, and where a number of producers are arranged in a battery the pipes are all conected with one main flue. As the gas is not a permanent gas, it has to be used immediately, and can be piped only 500 to 1,000 ft. The cost varies from $800 to $1,400, exclusive of connections, and a $1,400 producer will gassify fifteen tons of mine run coal in 24 hours. Pennsylvania anthracite buckwheat coal gives 170,000 cubic feet of gas per ton, and bituminous coal produces about the same amount. The anthracite gas, however, contains only about 138,000 H. U. per 1000 ft. of gas, while bituminous coal contains 157,000 H. U. for the same amount.

Gas producers may be classified into two general types:

(1). Natural draft producers, of which Siemens' is an example. These are not very efficient, and also require a considerable grate area. This type is used very little at present.

(2). Forced draught producers, comprising three distinct types—

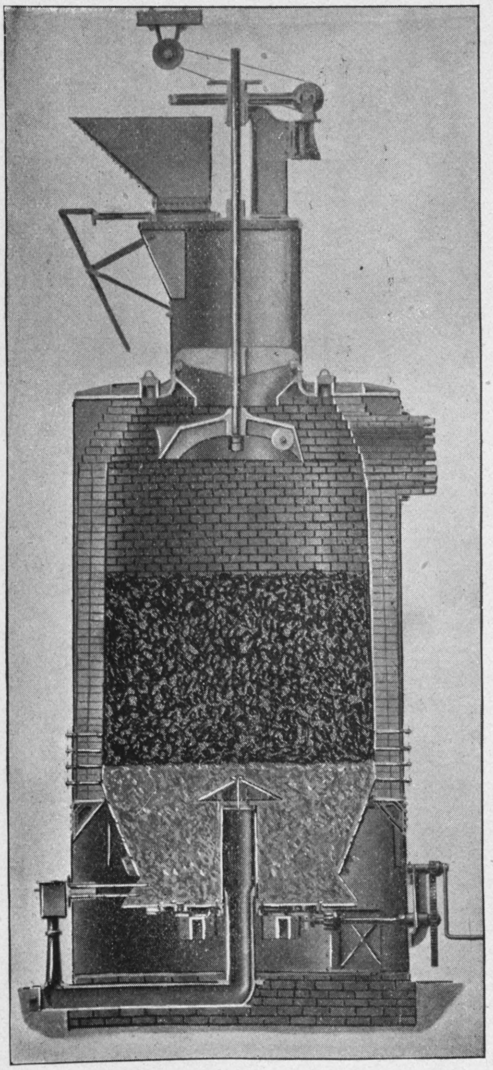
(a). Bar bottom producers. In these the fuel rests on the bars, beneath which the air and steam is blown. A battery of four producers of this type has been in use at the south rolling mill in this city for the past twelve years, and still gives very good satisfaction. The ashes are removed once a day by taking out the grate bars, the fuel being held in place meanwhile by paddles which are slipped in above the bars. The process of cleaning out the ashes can be carried through in about 20 minutes. During this time the producer is operated on natural draught, and therefore the cleaning interferes very little with the gas making. However, the bar bottom producers are seldom installed at present, except for very small plants.

(b). Solid bottom producers. These have no grate bars. The ashes rest on the sealed bottom of the producer, and the blast is carried to the center of the furnace by a conduit or a similar arrangement. A high pressure of steam can be used and a more rapid combustion obtained. This allows a deep bed of fuel and gives small percentages of carbon dioxide. The former objection to these, arising from the necessity of stopping to clean the ashes, has been overcome in the Wilson automatic, and the Taylor revolving bottom producer. The latter is made by R. D. Wood & Co., of Philadelphia, and consists of the usual brick-lined steel shell, having a sealed ash-pit below. The fuel bed rests on a flat iron table, which can be revolved by turning a crank on the outside of the producer. The blast of steam and air is carried in a pipe up through a deep ash bed to a point some few inches below the point of incandescence. Sight or test holes in the wall enable the operator to determine the frequency of turning the ashes down. Inequalities in the depth of the bed can be remedied by the use of the scraper bars arranged at four places around the producer. The Bildt automatic feed device is used on the Taylor producer. Uniform distribution, independent of the carelessness of attendants, is claimed for it.

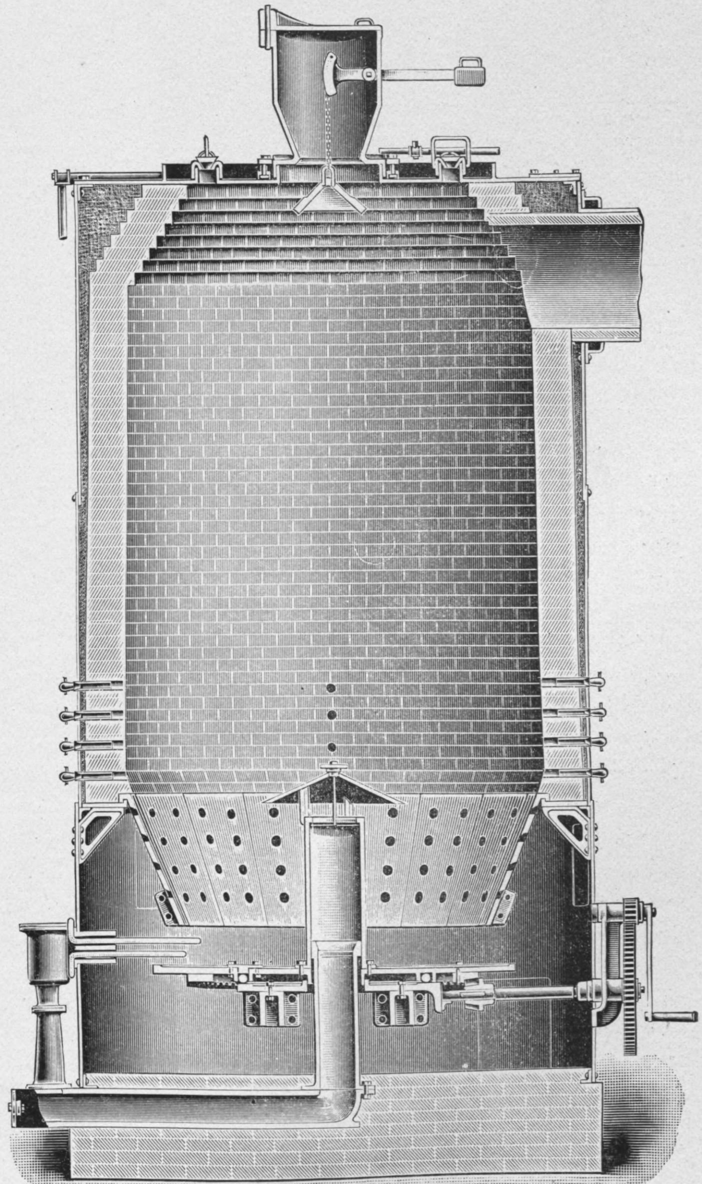
A modification of the brick-lined producer is a half water-jacketed furnace intended for use with clinker coals. But unless the heated water can be utilized in boilers, the method is a wasteful one.

(c). The third subdivision includes all producers which are sealed at the bottom by means of a water trough. Most of the producers now on the market belong to this class.

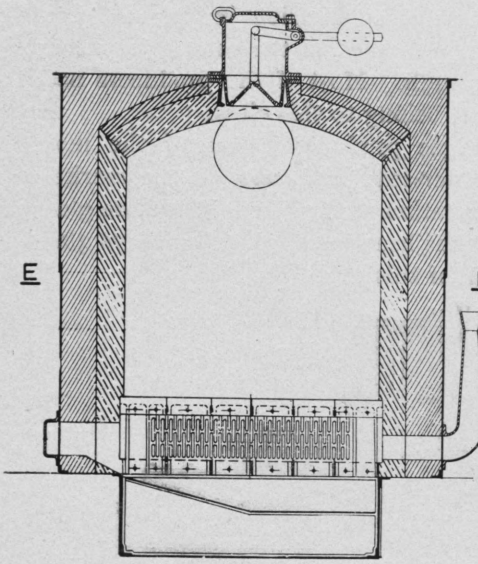
The Duff gas producer is one of the most prominent water-seal producers on the market. This is in operation at the North Baltimore glass factory, and has been installed at the Hays glass factory, both of this city.

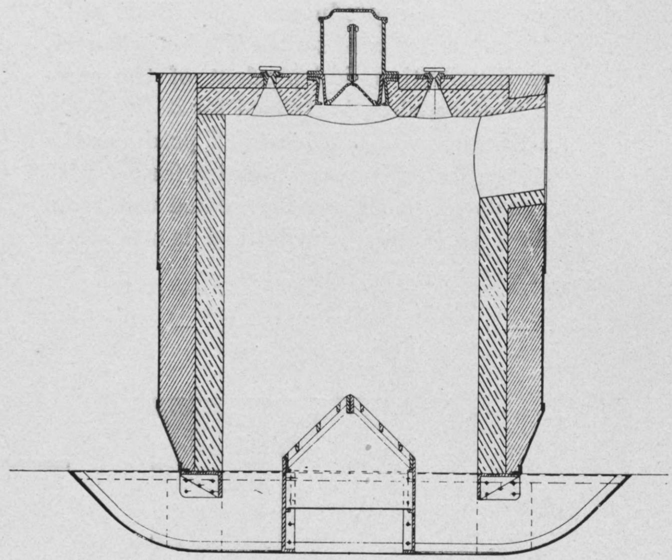


Taylor Producer.



Taylor Producer (Sectional View)





DUFF PRODUCER.

The feature of the Duff is the pointed grate and the air chamber beneath it. The steam jet induces a draught of air into the air chamber from which it is evenly spread through the entire fuel bed. This producer will withstand rapid working, a property which seems to be in favor with most manufacturers.

Many other examples of water seal producers might be given, but as most of them are strikingly similar, further comparison is hardly worth while in this article. However, a glance at the position producer gas occupies in the fuel question might be interesting.

The tendency of industrial progress is toward converting all forms of fuel energy into gas and utilizing the gas. Liquid fuels are converted into a gas or fine spray, and burned or exploded in that form. But the limited supply of petroleum and other oils, together with the increasing price, precludes the possibility of their playing any important part in the fuel problem. It is to coal that we have to look for a fuel supply, and the most economical manner of using coal is in the form of gas.

The three principal methods of converting coal to gas are: 1. Distilling the coal in retorts. 2. Forming water gas by a blast of steam on incandescent coke. 3. Forming producer gas by passing a blast of steam and air through hot coals. The last mentioned method gives more heat units per pound of coal than any other. The comparative simplicity of the process and the ease of working on a large scale, make it the most desirable form of gaseous fuel from coal. Producer gas will shortly replace all other forms of fuel where a considerable quantity of the gas is burned, although its relative weakness precludes its use in small operations. It is, however, along other lines than high temperature production that the greatest development is expected. In boiler firing it has been found that under favorable conditions producer gas firing secures more duty per pound of coal, insures a higher average of good work, more regular steaming, and tends to prolong the life of the boilers with a lessened cost of maintenance. This is explained by the fact that in the ordinary fire-box of a boiler the volatile hydrocarbons are driven off unburned, while in producer gas they are largely utilized.

The development of the gas engine during recent years has opened another field for producer gas. It was formerly supposed that producer gas would be too weak to run a gas engine, but many instances of the use of blast furnace gas directly in gas engines disproves the supposition. Blast furnace gas is very similar to producer gas, but has a larger per cent. of carbon dioxide, due to the reduction of the iron ores. This gas has long been used for all the heating about blast furnaces, but recently it has been applied directly in the engine with considerable success. It is along this line that the most work is being done at present, and several engines have been offered for the special use of producer gas.

The successful application of producer g s to engines suggests another probability in the direction of electric power plants. The present practice is to have very large power plants using high units of steam, generating and conducting the electricity at high potential to substations, and transforming to low potential. With the utilization of cheap gas in gas engines, small plants can become just as efficient as large ones, and do not entail as much loss from frequent transfers of energy.

Producer gas is used as an aid in cleaning poor ores. When non-magnetic ores are subjected to the action of a reducing gas at red heat they are rendered magnetic. Ores thus treated are then separated from the dirt by powerful magnets.

Some attempts have been made to collect the by-products. The removal of the tar entails a loss estimated at from 10 to 20% in the heating power of the fuel.

In the Wilson and some others the distillation gases are made to pass through the incandescent fuel, and the tarry matter is thus broken up into solid carbon and permanent gas. It is possible that the same thing takes place in the generators used with the ordinary producer, and that the solid carbon deposited is burned on reversing the gases.

This indicates that a condensation of the coal tar and ammonia would be the best means of saving of the biproducts, and that it might be done without a considerable loss to the heating power of the gas.

As regards the form of the producer itself there has been very little originality shown in the enormous number of patents which have been granted. In many cases, absolute ignorance of the principles of gas production has been displayed. Producers have been attempted to suit all purposes. This is impossible, and special cases need special designs. It has been suggested that future producers will be modeled more after the blast furnace, and this may necessitate the addition of a limestone or earthy matter to form slag. However, large consumptions could be effected with small grate areas.

In conclusion may be added a note as to the coal desirable for gas making. A good, clean bituminous coal, low in ash and moisture and high in volatile matter, gives the best results, and the higher the constituent of volatile matter the higher are the temperatures obtainable. In these respects the Indiana coals compare favorably with the best Pittsburg gas coal. Many of the coals mined in the vicinity of Terre Haute have been used successfully in making producer gas, and the few producers already operating have demonstrated that Indiana coal will be a satisfactory substitute for natural gas.

Modern Cars.

By ROBERT K. ROCHESTER, '01.

ONE of the greatest and most rapid changes noticeable in America's swift progress is that which has been wrought in the mode of travel and the conveyance of freight. During early years of the Republic, when travel was not indulged in to any great extent and the distances to be traversed were comparatively small, but little heed was given to the means of locomotion, the ordinary domesticated animals and beasts of burden, with their slow but steady speeds, satisfying the meager desires of a people whose wants were few and simple. With the increase of population and consequent expansion of cultivated land, however, came, as a natural sequence, the desire for better means of travel and better facilities for the conveyance of the products of the land. Heretofore each settler ran an independent establishment of his own; he could exist without the aid of his neighbors. But just about this time began that great process of specialization which has been one of the principal features in the success of the American people. Certain portions of the then cultivated lands were capable of producing larger crops of certain necessities than were other portions, while some localities abounded in materials which were entirely lacking in other districts. To adjust this inequality of products, some means of transportation was necessary, and one of the first and most natural means was by water.

Soon, however, as the inland population increased, this means became inadequate and the pack train was resorted to, this being the popular method of transportation for many years. The pack train was an expensive, laborious and tiresome method of transportation, and where roads were praticable it was gradually superceded by the wheeled conveyances, which, in their infancy, were exceedingly crude and inefficient. Following this method came the wheeled conveyances which tracked in specially prepared roadways and were propelled by an intrinsic power. This method of locomotion, with numerous changes and improvements, is the mode in vogue today, with few exceptions.

Natural inland waterways were, and are still used where practicable, and some few canals were constructed. The enormous first cost of these constructions makes them almost prohibitory, however, and at the present time, although the canals and waterways furnish an exceedingly cheap means for transporting heavy and bulky articles, the lack of speed, which is a requisite to the conveyance of most articles of commerce, makes them absolutely useless as a means of transporting many of the commodities of the present time. An exception may be taken, however, in the transportation of coal and cotton on the Ohio and Mississippi rivers with their navigable tributaries, and the transportation of ore, wheat and timber on the great lakes. The immense quantities of the above mentioned commodities thus transported during the season of navigation on the great lakes is somewhat astonishing. Immense steel freighters, many of them towing consorts of equal magnitude, are constantly plying between Duluth and the various ports of Lake Michigan and Lake Erie, laden either with the richest and most easily worked iron ore in the world or with the valuable wheat of the Dakotas and Minnesota. Many of them return loaded with coal, while still more proceed hastily to the head of the lakes to again receive a valuable cargo from the productive north-west. This furnishes a cheap and convenient means of transportation, but by far the larger problem is to collect this cargo from the mines and scattered wheat fields and so dispose of it as to have it on hand for the rush of the boats during the summer months. This is accomplished by means of the modern railways with their ever-increasing mileage and equipment. Throughout the year immense trains of cars whose capacity has gradually increased from twenty to forty, or even fifty or fifty-five tons, are constantly being dragged towards their destination by immense mechanical units which are in themselves wonders to the person of average engineering education.

With the increase of population and consequent expansion of territory also came the greater demand for speedy transportation between distant points, and out of the necessity for rapid transit came the demand for luxurious traveling accommodations. To meet these ever-increasing demands a perfect network of steel rails now traverses the continent in every direction, spanning rivers and swamps, climbing and descending mountains, and stretching, apparently without end, across the treeless plains.

These railroads have played an important part in the development of the country, and many of them have to a certain extent created a demand for themselves by opening up new lands, which, without modern facilities for transportation, would still retain their riches undisturbed.

In order to supply the many thousands of cars which are in daily use, several large corporations are now in existence throughout the country, employing thousands of men who toil from year to year to replace those cars which are discarded on account of age and destroyed in wrecks, and also to supply the continual demands which new roads and increased traffic are creating.

Comparatively few of the many thousands of people who either ride in cars or are continually seeing them pass have but a vague idea of the intricate construction in a modern railway conveyance. Especially is this true of the modern luxurious sleeper, commonly referred to as the Pullman, where every inch of space is utilized to the best advantage.

The demands and restrictions placed upon the car builder of today are numerous, to say the least. He must design his car so as to give a maximum amount of space with minimum expense and amount of material, at the same time making a design which will be serviceable and pleasing to the eye and still not detract from the strength of the car. The continual jarring and shaking which a car is subjected to while being propelled at lightning speed is a most trying ordeal, and one to which few framed structures are ever subjected. Every joint must fit tightly, every screw and nut must be in perfect adjustment, and so far as possible all lost motion must be eliminated; in short, everything must be right, or disaster will result. Materials of the finest grade must be employed in every particular and parts liable to excessive wear must be proportioned accordingly and the design so made as to permit of ready examination of all parts liable to give trouble. The failing of any one of the numerous details, such, for instance, as the falling of a brake beam upon the rails, the breaking of an axle, the tearing of a flange from a wheel, or any one of a hundred accidents which may occur, either through faulty construction or neglected inspection, may result in the loss of many lives or the destruction of many thousands of dollars worth of valuable property and the expensive delays which usually accompany a wreck. The car of today is the outcome of many years of patient toil and the careful observance and consequent avoidance in design of the numerous sources of accidents.

PASSENGER CARS.

Great care has to be exercised in selecting material for the long and heavy passenger coaches which are now in use. The productive southern forests, as well as those of British Columbia, are being scoured for the long and straight timber which is needed for sills and similar purposes. Long and short leaf yellow pine are the woods mostly used, but the fir which comes from the colder regions possesses a toughness and stiffness which makes it a valuable wood for car work.

More steel is gradually being used in passenger car work, and while some time ago tension members alone were constructed of metal, at present the pratice is to replace many bulky wood members by steel. Until the advent of the vestibule the greatest danger in wrecks was the telescoping of cars, the passengers who were so fortunate as to escape injury due to the collisions being in immediate danger of a more horrible death by fire, for escape is usually impossible, and most wrecks begin to burn immediately. By a judicious use of steel, passenger cars as constructed today are rendered practically non-telescopic when equipped with vestibules. A contrivance known as an anti-telescoping device is now being placed on all modern passenger cars, and consists of a ½″×8″ steel plate sandwiched between the side sills, which are made double, and securely bolted to the same. This plate extends back about 20 ft. from the end of the car and adds considerable rigidity to the sills. Between the end sills a similar plate ¾″×8″ is securely fastened, and the end posts are made double and have ¾″×3½″ steel plates securely imbedded in them. These upright steel plates are securely fastened at the bottom to a similar plate which is imbedded in the end sills and at the top to a heavy plate, which ties the entire structure securely together. The plates between the side sills are also fastened to the plate between the end sills.

This construction makes a steel cage of the end of the car, and where used in connection with a good vestibule makes it an utter impossibility to telescope a car. It would probably buckle in the center before it would give way at the ends.

Not long ago two trains of exceptionally fine cars were turned out of one of the larger car works, and shortly after leaving the shop one of them ran into an open switch and crashed into a freight train which was standing on the siding. This train was equiped throughout with the non-telescopic device above referred to and vestibules and platforms of an approved type. Although both locomotives and several freight cars were badly damaged, the only injury to the passenger train was a general shaking up and the caving in of the front end of the first car, which was a stub end baggage coach. This would probably not have occurred had the engine tender been equipped with a vestibule diaphragm as is now frequently done. The vestibvles on the remaining cars were not strained enough to cause the doors to stick, demonstrating beyond doubt that perfect safety is secured by the use of steel end construction and solid vestibules throughout.

Quite an intricate problem arises in heating, lighting and ventilating coaches. The heating is usually done by steam supplied from the locomotive, although some cars are still equipped with hot water heaters, each coach having its own heating plant. The method used for lighting most cars is what is known as the Pintsch system. This consists of compressing illuminating gas to a high pressure and storing it in large steel tanks which are carried beneath the car floor; by the use of a suitable reducing valve this gas is fed to the burners at a low pressure. This furnishes a safe and convenient method of illumination at a reasonable cost, and is in use on a vast majority of the roads.

Acetylene is being experimented with, but the danger which usually accompanies the use of this gas will probably prohibit its use for car illumination. Electricity is also being used to some extent for lighting the more luxurious cars. One system has a dynamo run from the car axle and uses a storage battery which is kept charged and is only used when the dynamo is not running. When the car is in motion current is supplied directly from the dynamo. Another system consists of a complete lighting plant situated in the front end of the first car, which is usually termed the dynamo car. At present this is the most satisfactory method of electric illumination.

In order that a coach may be able to stand the weather, for they are seldom housed unless sent to the shop for repairs, especial attention is paid to the exterior finish. Not only must the exposed portion be able to withstand the driving sleet and rain and the extremes of temperature, but also the grinding influence of the hot cinders which beat against the highly finished surface with considerable force, caused by the speed of the train. The roof or deck of a car is usually covered with tin, or sometimes with heavy canvas, and then coated with some durable paint. In finishing the exterior of a car a coating of paint composed chiefly of good oil and called a priming coat is first applied and allowed to penetrate the pores of the wood. This is followed by two coats of lead which are allowed to harden thoroughly and then rubbed down by hand. A piece of soft sandstone is drawn across the surface and water applied constantly until a perfectly smooth surface is secured, then two coats of coloring are applied and allowed to dry. Then follows a coat of varnish which is allowed to harden for several days, when it is rubbed down with a very fine sandpaper. The lettering is then applied and one or two final coats of extra fine coach varnish is carefully brushed on. The materials used are of the finest and great care must be exercised in applying the varnish and all drafts of cold air carefully avoided until the varnish has set. If dried too suddenly the result is very disastrous, as cracks appear and the entire surface has to be removed and the process of varnishing repeated.

To estimate the average life of a passenger car is a difficult proposition, for most of them last until they are wrecked and burned or so damaged as to render it uneconomical to repair them so that they may again be put in service. It is customary to overhaul cars as the interior decorations become old and worn, and to again place them in service. Many cars which were built twenty or thirty years ago are still in service, and some of them are now being overhauled and will continue in service for some time to come. In overhauling a car the entire interior finish is removed and all the framing carefully inspected and repaired, also being strengthened if necessary. An entirely new interior is then built into the car, and it is again ready for the road after having been carefully repainted and varnished.

FREIGHT CARS.

During recent years quite a marked development is noticeable in the freight equipment of the larger railroads. The old twenty ton car is being rapidly superceded by cars of twice, and in some cases almost three times, this tonnage, the aim being in all cases to reduce the percentage of dead load, or non-paying freight, to live load, or paying freight.

The construction of wooden freight cars is naturally decidedly more simple than that of the passenger coach. The ordinary freight car consists primarily of six or eight longitudinal sills with suitable and substantial end connections, all securely trussed and tied together. In freight cars the same increase in the use of iron and steel is noticeable as in passenger work. Some years ago the ordinary wooden car was amply strong enough to resist the fair usage to which it was subjected, but with the introduction of cars of larger capacity, and the numerous changes in the methods of handling them, these cars are rapidly being pounded to pieces.

The average life of a wooden freight car is usually taken as about ten years, but there are many cars in use at present whose life will be considerably shortened on account of the excessive usage to which they are being subjected. A few years ago cars were designed to run in trains of 600 tons, while today many of these cars are being worked in trains whose tonnage is 2100, and sometimes more. The result is, of course, very disastrous, and many of these cars are being consigned to the scrap heap, as repair bills are rapidly eating up the profits.

The introduction of the automatic coupler and air brakes, with which all cars must by law be equiped, has demanded a decided increase in the size and strength of most of the members composing a freight car frame. The rough handling which most cars now receive in switching yards is partially due to the fact that with the automatic coupler it is unnecessary for the switchman to go between the cars when they come together, consequently, and in order to save time, they are usually kicked together with considerable more force than is necessary for coupling.

The demand for increased capacity rendered the ordinary wooden cars exceedingly bulky and expensive to maintain. This demand has been met, however, by the modern steel car. These cars are at present built in two classes, those whose respective pieces are pressed from steel metal and consequently termed pressed steel cars, and those whose members are built up of ordinary or specially rolled steel forms. The cars which belong to this class are usually termed structural steel cars. Each have their respective merits, but the latter are more readily built and repaired.

No one can at present predict the life of a steel car, as none of them have been in service long enough to form conservative judgment. The rapid deterioration of the metal which was at first predicted has not developed to any alarming degree, and with proper care no trouble need be anticipated from this source. Some coals which abound in sulphur compounds cause trouble from the sulphuric acid which is formed when water is allowed to come in contact with the coal.

It is an acknowledged fact among railroad men, however, that the steel car has come to stay, as the continual demand for choice timber has drained the once ample forests, and as the price of timber is continually increasing, so is the cost of steel continually decreasing, and the methods of working it being constantly improved. It is only a question of time till the steel car will almost entirely supplant the timber construction.

The very rapid develpment of cars of large capacity, and the great increase in size of locomotives, has left the ordinary forms of draft rigging far behind, and heavy trains are frequently hauled with the draft gears on a large number of cars stretched out so that the springs are solid, the spring capacity being entirely absorbed. The train then resembles a chain with practically no elasticity except that which cars themselves possess.

The strains to which the couplers, draft rigging and cars themselves are subjected when this condition obtains, are exceedingly severe and work havoc in the car framing. While cars were comparatively light and built almost entirely of wood (which is a very yielding material) the strains were not excessive, and with good designing and construction, together with care in the selection of materials, were readily withstood.

The introduction of the heavy steel car, however, has radically changed the condition of affairs and the amount of elasticity which a car itself possesses has greatly diminished, and consequently enormously increased strains have been produced, which have also been augmented to no small extent by the introduction of larger locomotives. A limited space only is allowed for spring capacity, and even if there were space it would not be desirable to increase the spring capacity, as this would also produce a corresponding increase in the recoil, and this would probably be as bad as the first difficulty. The chief cause of trains pulling in two where a sag is encountered is the lack of suitable draft gears.

To meet these demands numerous friction draft gears have been devised, but so far none have come into general use although many have shown excellent records in service. Measures must be taken, however, to remedy these evils, and an efficient friction rigging with as few parts as possible, and these readily accessible, will probably be the solution of the problem.

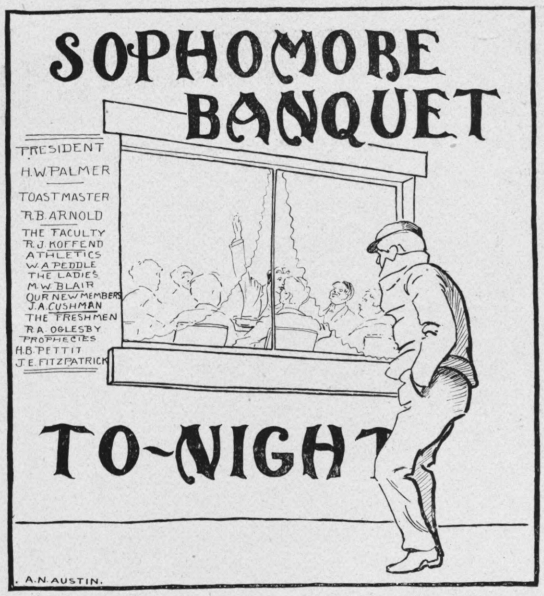
RESOLUTION OF CONDOLENCE.

Whereas, Our esteemed Instructor, Mr. R. L. McCormick, and our fellow student, Mr. Augustus McCormick, have suffered bereavement in the death of their father,

Resolved, That we, the Student Council of the Rose Polytechnic Institute, express to the bereaved family the most sincere sympathy of the Student Council and the Student Body.

Resolved, That these resolutions be spread upon the records of the Student Council, that a copy be sent to the family of Mr. McCormick, and that a copy be sent to the TECHNIC for publication.

Committee.



THE SOPHOMORE BANQUET.

This year, contrary to the usual custom, the Freshmen as a class made no attempt to prevent members of the Sophomore class from attending their banquet, a circumstance due to the fact, no doubt, that previous to the event both classes received a warming from the throne, which had the desired effect. The Sophomores left the Institute in a body and reached the Terre Haute unmolested by Freshmen. Covers were laid for thirty-five and all were at their places when President Harry W. Palmer addressed the class. R. B. Arnold acted as Toastmaster. Those responding to toasts were R. J. Koffend, The Faculty; W. A. Peddle, Athletics; M. W. Blair, The Ladies; S. A. Cushman, Our New Members; R. A. Oglesby, The Freshmen; B. Pettet and J. E. Fitzpatrick, Class Prophesies. During the evening several freshmen were admitted to the banquet hall and three cheers given by the banqueters for naughty-four made it still more evident that the hatchet now lies buried between the classes.

JUNIOR BANQUET.

With the usual Sophomore and Freshmen banquets and rumors of banquets, came pleasant memories to the minds of the Juniors. Memories led to wishes, and wishes to action, and as a result the class of '02, fifteen in number, gathered at the Terre Haute House on the evening of February sixth. At 8:30 the class seated themselves around the banquet table to royally feast on the fat of the land.

No formal toasts were given, but a number of impromptu speeches were made, and after a toast to Dr. Mees, there followed a most exciting debate as to the popularity of certain instructors. Jokes, songs and stories followed one another in rapid succession, and it was with genuine regret that the party watched the hour of parting approach.

After mutual well-wishing and hopes of all being present a year hence, the "R. P." yell was given with a vengeance, and the boys departed with the unanimous opinion that the banquet was the most pronounced success of the banquets of '02.

SCIENTIFIC SOCIETY.

Three meetings of the Scientific Society have been held since last report. The first paper was by R. K. Rochester, of the Senior Class, on "Modern Cars." The address was illustrated by several slides. It was one of the most successful of the series, and the attendance was better than before. The article appearing in this issue of the TECHNICis an abstract.

The second paper was by F. R. Fishback, '02, describing in detail the preparation of printing plates for the modern newspaper. Methods of typesetting, including the linotype method, were discussed, and the way in which curved stereotypes are prepared for use in cylinder presses was illustrated. This is a subject of much general interest, and was well treated.

On Saturday, February 9, V. A. Hommel, '02, gave an interesting description of the methods of Champagne manufacture. He described in detail the process, from the fresh-gathered grape to the final product. The unusual subject, and the speaker's thorough knowledge of his subject lent especial interest to the talk. Photographs of different parts of the establishment of M. Hommel & Co., of Sandusky, Ohio, were shown in connection with the lecture.

THE Athletic Association is making great efforts to arouse a suitable spirit of athletics for the spring meet, and for the base ball season which is almost upon us. Rose should and ought to be one of the leading colleges in the state in athletics, if every man would do his duty and not be afraid of a little work. It is true, there is no financial reward for their efforts, but there is the reward of good health and an increased animation and desire for study when the play is over. As one of Rose's old track men said several years ago—and he was one who did not come in last every time, either—upon the decision of the school to withdraw from the field meet, "I do not feel bad on my account, as I have gained a great deal from the training done this year, not only in bodily feeling, but my work has been better in school. The men I feel for are those who have trained me this year and can have no prospect of allowing me to show them what their efforts availed." If every man in Rose would talk like that, and act up to their words, we wouldn't finish next to last in the state meet, but would return to our old position that we held for six years at the head of athletics in Indiana. Now let us see this year, if we can not help wipe out the disgrace of this last two or three years and show the alumni of Rose that the old spirit is still here.

The ball outlook for the spring is very encouraging, and Captain Gibbons feels that Rose will have a team this year that will give a good account of itself on the diamond. A very large percentage of the Freshman Class are also base ball men, and a large number have announced their intentions of trying for the team. The relative abilities of the different men are, of course, entirely in the dark at this time, but there must be some good material in such a large and athletic class, and putting these with the old men—and, by the way, last year's team has only been decreased by two men—Rose should win a majority of games. Manager Crebs is arranging a good schedule for the season, and games will probably be played with DePauw, Wabash, Indiana University and Bradley Polytechnic, and several others are to be contracted for.

The Athletic Association has made arrangements to give gymnasium lessons during the winter term, the system which was pursued last year. The hour plan has been so changed that the students will all be free to attend the classes, which are held on Tuesday, Thursday and Saturday afternoons. President Huthsteiner may take charge of the class this year, but if he is unable to do so, it will be divided, and Messrs. Cox and Jacobs of the Sophomore Class will take charge of the work. The Directors have also decided, with a view of encouraging athletics, to hold an indoor inter-class meet on February 21. It is the intention to make this a handicap meet and award prizes to the winners of the various events, and to the classes obtaining the largest number of points. The events will be restricted, as far as possible, to those which will occur in the regular State meet in May.

The second of the inter-class basket ball contests took place in the gym. Saturday afternoon, Jan. 19, between the Sophomore and Freshmen teams. The game was entirely one-sided, and the Sophomores had very little trouble in running up the high score of 28. The Sophomores showed the advantage of more practice and team work. The individual work of Barbazette and McNab was perhaps all that can be mentioned of the Freshman team. The line-up and the score was as follows :

FIRST HALF.

SOPHOMORES.	Field Goals	Foul Goals	Fouls	FRESHMEN.	Field Goals	Foul Goals	Fouls
I. J. Cox, f.	2	1	0	McNab, f.	1	1	1
H. C. Gilbert, f,	1	0	2	Schroeder, f.	0	0	3
S. Arnold, c.	0	2	0	Staff, c.	0	0	1
F. Rumbley, g	2	0	2	Barbazette, g.	0	0	0
Fitzpatrick, g.	0	0	0	Merriman, g.	0	0	3

SECOND HALF.

SOPHOMORES	Field Goals	Foul Goals	Fouls	FRESHMEN.	Field Goals	Foul Goals	Fouls
I. J. Cox, f.	0	0	1	McNab, f.	0	0	2
N. H. Cox, f.	1	0	0	Schroeder, f.	0	0	2
Arnold, c.	1	2	1	Staff, c.	0	1	2
Rumbley, g.	1	0	2	Barbazette, g.	0	0	0
Katzenbach, g.	1	0	0	Merriman, g	0	0	0

SOPHOMORES, 23; SENIORS, 11.

The first of the inter-class basket ball contests took place at the gym. between the Sophomore and the Senior teams, in which the Sophomores were successful by a score of 23 to 11. All the men were at the game for the season, and the game as a consequence was rather poorly played. Hadley and Pfleging played the best game for the Seniors, while the whole Sophomore team assisted in winning the game. The score was as follows :

FIRST HALF.

SENIORS.	Fouls	Field Goals	Foul Goals	SOPHOMORES.	Fouls	Field Goals	Foul Goals
Miller, f	0	0	0	I. G. Cox, f.	0	2	1
Pflegging, f.	1	2	0	H. Cox, f.	0	1	0
Hadley, c.	0	1	1	Arnold, c.	1	0	2
Troll, g.	1	0	0	Katzenbach, g.	1	1	0
Clay, g.	0	0	0	Rumbley, g.	2	0	0

SECOND HALF.

SENIORS.	Fouls	Field Goals	Foul Goals	SOPHOMORES.	Fouls	Field Goals	Foul Goals
Miller, f.	0	0	0	I J Cox. f.	0	4	0
Huthsteiner, f.	0	0	0	H. Cox, f.	0	0	0
Hadley, c.	1	2	0	Arnold, c	0	2	0
Troll, g.	1	0	0	Katzenbach, g.	1	0	0
Clay, g.	4	0	0	Rumbley, g.	0	0	0

Score—Sophomores, 23; Seniors, 11.

T. H. H. S., 20; ROSE, 18.

The school basket ball team made its first appearance on the evening of January 14, when they met the High School team in the Rose gym. There was a good attendance at the opening game, including a large number of the fair sex. Of course the rooters for both teams were on hand and rooted. The Rose men put up a good exhibition in the first half, and it was generally thought that the High School boys would not have a show, but such was not to be case, as they braced up in the second half and rushed the Rose men off their feet and had them winded before the half was over, winning by a score of 20 to 18. Our team showed greatly the lack of practice and team work, a thing which the high school team had perfected to a high degree. The best individual work on the Rose team was done by Pfleging and Cox, while Townley and Steele led the High School boys. The defeat was especially hard to bear, as the High School had defeated the Normal, and Rose expects to play them a series of games this year. The line-up and score was as follows :

FIRST HALF.

ROSE	Fouls	Field Goals	Foul Goals	HIGH SCHOOL.	Fouls	Field Goals	Foul Goals
Cox, l. f.	0	1	0	Townley, l. f.	1	0	0
Pfleging, r. f.	4	2	2	Reynolds, r. f.	2	0	0
Hadley, c.	1	0	1	Steele, c.	3	0	3
Barbazette, l. g.	4	0	0	Gilkerson, l. g.	0	0	0
Arnold, r. g.	0	0	0	Tipton, r. f.	0	0	0

SECOND HALF.

ROSE	Fouls	Field Goals	Foul Goals	HIGH SCHOOL.	Fouls	Field Goals	Foul Goals
Cox, l. f.	1	2	1	Townley. l. f.	2	1	2
Pfleging, r. f	2	0	2	Reynolds, r. f.	0	0	0
Hadley, c,	2	1	1	Steele, c.	5	2	4
Barbazette, l. g.	1	0	0	Gilkerson, l g	0	2	0
Arnold, r. g.	3	0	0	Tipton, r. g	0	0	1

Score—Rose, 18; High School, 20.

Time of halves, 15 and 20 minutes.

Referee, Charles McCormick. Umpire, Attridge, Y. M. C. A.

Y. M. C. A., 32; ROSE, 6.

The basket ball team was defeated on Feb. 2 by the strong Y. M. C. A. team, in the Y. M. C. A. gymnasium. There is no excuse to offer for the defeat. They were simply outplayed, but it is hoped before the next game takes place that the boys will improve so that the score will be different. The night was bad, and the attendance as a consequence very poor, and very little enthusiasm was shown over the game by the supporters of either side. The Y. M. C. A. boys played with a snap and vigor, and did some remarkable passing and goal throwing. The team work was above reproach, and every man was in the game every minute. The Rose men played with just as much vigor, but did not have the system and team work that their opponents had, and were hindered somewhat by the strange gymnasium baskets, but this could not account for the defeat. It was simply better playing on the part of the Y. M. C. A. boys. The score was as follows:

FIRST HALF.

ROSE.	Fouls	Field Goals	Foul Goals	Y. M. C. A.	Fouls	Field Goals	Foul Goals
Katzenbach, f.	0	0	0	Heinig, f.	0	3	0
Pfleging, f.	1	0	1	Tipton, f.	0	0	0
Hadley, c.	1	1	0	Trueblood, c.	0	2	0
Arnold, g.	0	0	0	Connors, g.	0	1	0
Barbazette, g.	0	0	0	Ault, g.	2	1	0

SECOND HALF.

ROSE.	Fouls	Field Goals	Foul Goals	Y. M. C. A.	Fouls	Field Goals	Foul Goals
Katzenbach, f.	1	0	0	Heinig, f.	1	1	0
Pfleging, f.	3	0	3	Tipton, f.	1	1	0
Hadley, c.	1	0	0	Trueblood, c.	1	3	2
Barbazette, g.	1	0	0	Connors. g.	0	1	1
Arnold, g.	3	0	0	Ault, g.	5	1	1

Score—Y. M. C. A., 32; Rose, 6. 20 minute halves.

T. H. H. S., 17; ROSE, 20.

On January 20 the team redeemed itself for the defeat of the week previous by defeating the same team representing the High School to the tune of 20 to 17, and this in the Y. M. C. A. gym., which is the training place of the High School team, and to which the Rose men were strange. The game at the end of the first half looked very much as if it was to be again a High School victory, with the score standing 13 to 8. The second half showed a remarkable reversal of form. The Rose men got together and carried the ball from one end of the gym. to the other, keeping it always in the neighborhood of the High School goal. The men played a quick, accurate passing game, and very few fumbles or mistakes were made on the part of Rose. The High School boys, however, went up in the air and could do nothing. Every time a High School man got the ball there would be his opponent opposite him, and if he did not prevent the throw another Rose man would get the ball when it was thrown. Barbazette played a very good game at left back, returning the ball time after time when it was thrown into Rose territory by a High School man. At the same time Pfleging was doing the best work in the High School territory, throwing three goals in the second half from the field, besides this making eight goals from fouls out of twelve chances. For the High School, Steele easily carried off the honors, among other things making the two most difficult throws of the game. The score was as follows:

FIRST HALF.

ROSE.	Fouls	Field Goals	Foul Goals	HIGH SCHOOL.	Fouls	Field Goals	Foul Goals
Cox, l. f.	3	1	0	Townley, r. f.	2	0	0
Pfleging, r. f.	1	0	4	Reynolds, l. f.	1	0	0
Hadley c.	0	1	0	Steele, c.	2	2	3
Barbazette. l. g.	0	0	0	Gilkerson. r. g.	2	1	0
Arnold, r. g.	1	0	0	Tipton, l. g.	1	2	0

SECOND HALF.

ROSE.	Fouls	Field Goals	Foul Goals	HIGH SCHOOL.	Fouls	Field Goals	Foul Goals
Cox, l. f.	0	0	0	Townley, r. f.	0	0	0
Pfleging, r. f.	3	3	4	Reynolds, r. g.	1	0	0
Hadley, c.	1	1	0	Steele, c.	1	1	2
Barbazette, l. g.	1	0	0	Gilkerson, l. f.	1	0	0
Arnold, r. g.	3	0	0	Tipton, l. f.	1	0	0

Score—Rose, 20; High School, 17.

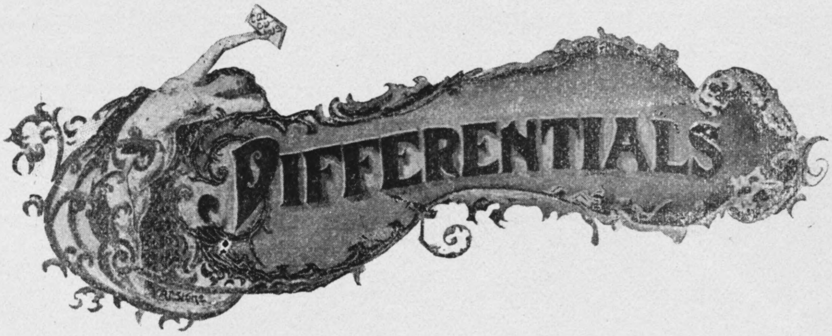
Referee, Charles McCormick. Umpire, Cecil Trueblood, Y. M. C. A

Time of halves, 20 and 13 minutes.

BASE BALL SCHEDULE.

Mgr. Crebs of the base ball team has about completed the schedule for the Spring. The first game, on April 6th, will be a practice game with a High School team. There is a prospect of playing at Indianapolis with the High School there on that date. The date with Wittenberg here has not yet been settled. The schedule, as arranged, is as follows:

April 6. Indianapolis High School, at Indianapolis.
" 13. DePauw University, at Terre Haute.
" 27. Wabash College, at Terre Haute.
May 6. DePauw University, at Greencastle.
" 18. Bradley Polytechnic, at Terre Haute.
" 30. (Decoration Day). Wittenberg College, at Springfield, Ohio.
June 1. Bradley Polytechnic, at Peoria.
" 8. Wabash, at Crawfordsville.



Levi, before the banquet, "I'm going to eat and keep my mouth shut."

Hills, reciting—"He tasted the soup and said it was too much hot."

Burt regards all concentrated acids as dangerous since his experiment with arsenic.

Schefferley, translating (evidently at sight)—"And he went somewhat in front bent over."

The lockers in the gymnasium have been arranged so that they may be fastened with padlocks.

Notice was given recently that all Thesis subjects must be submitted by the Seniors before February 16.

In a game between the Sophomore classes of the Normal and the Polytechnic, the Poly team won by a score of 25 to 15.

A new and very convenient set of clamps for almost universal use have been made in the shops for the Physical Laboratory.

Faculty committees have for some time been engaged in careful study with regard to desirable changes in the course of study.

The chemical laboratory is again to have ample fire protection. Fire Chief Wiedemann has again assumed the official wash-bottle.

Hath—" Mr. Fishback, please recite."

As Mr. Fishback is not in sight, the Professor finds him in the hall and brings him in.

Several of the Freshmen who cut shop when the banquet of the Sophomores was announced, were suspended from the Institute for a short time.

It is sometimes pleasant to see with what grace an instructor can tell the last members of a departing class that they can go if they will make it up.

Prof. Wickersham has introduced a plan involving extemporaneous speaking by the members of the Senior Language class. It appears to be a good one.

During the absence of Mr. McCormick from school, his classes were taken in hand by Dr. Mees and Professor Hathaway. Hath was a new one on the boys.

Activity in gymnasium work has been evidenced by the accompanying breakage. Lamp-globes have been short lived, and window-panes have kept the carpenter busy.

Previous to the delivery of the Scientific Society paper on Champagne, inquiries were frequent and anxious as to whether the author would submit samples of the finished product.

At a meeting of the Sophomore Class M. H. Cox was elected Captain of the class team entered for the indoor athletic meet to take place on Feb. 18th. W. McGill was elected manager.

The Seniors of the Chemical course were entertained at dinner by Dr. and Mrs. Noyes on the evening of January 26. A very enjoyable evening was spent, and the hospitality of the Doctor and his wife was greatly appreciated.

News has been received that letters requesting catalogues of various firms, and coming from this neighborhood, have not only flooded the Terre Haute postoffice, but exhausted the edition of several of the most popular advertising books.

Some of the catalogue-fiends get as much mail as one of the Freshmen did last term.

Warren, '02, has taken up a problem in connection with the structure of camphor, in his Chemical Laboratory work.

Gymnasium classes are being held regularly twice a week, with a prospect of three times a week. The classes are very well attended, and a good deal of interest is shown. Capt. Gibbons has posted a notice that all candidates for the ball team must join the class.

Two of the Senior Chemists are making a comparison of the producer gas made and used at the different manufacturing plants in the city. Samples have also been taken, with a view to ascertaining whether the color of the gas issuant from the producer gives an indication of its quality.

In a challenge posted recently, for a Basket-ball game between the two sections of the Sophomore class, the writer displayed a surprising command of the vocabulary of invective. The chances of redress for the aggrieved section, howerer, are poor, as the challengers can show by far the stronger team.

Friday, January 18, was the date of a very enjoyable "Good Time" given by the Y. M. C. A. at their room. The attendance was good, and evening was thoroughly enjoyed by those present. Games were played in great variety, and bananas and ginger-snaps wereconsumed in corresponding quantity.

The new storage batteries, which are about completed, promise to be very efficient. There are 26 cells in all. Ten are of a 160 ampere-hour size, and sixteen 40 ampere-hours. The arrangements for connecting the cells in different combinations have been designed by Prof. Kendrick, and will be very convenient.

A week or so since, there appeared on the Bulletin-board a strange document. It was a small slab of wood evidently prepared in the shops, with the inscription, "G. G. Schneider, '04. Get a hair cut. Not a 15c. one either. Contributed by Sec. B." On the lower part of the board were glued five nickels. It is not reported as to whether or not the advice and the wherewithal were accepted.

Soph. B. recently distinguished itself by an emblem which was placed upon the board in Prof. Hathaway's room. Beneath a large globe, with a belt around it, was the inscription, "'03, the class that made R. P. I. famous." Here applies the old proverb, "He that bloweth not his own horn, verily the same shall not be blew."

In a letter recently received by a student, John T. Dickerson, ex-'01, expressed doubt as to his returning to Rose next year, as he had planned to do. He has recently accepted a very desirable position with the Wisconsin Bridge & Iron Co., of North Milwaukee, Wis. There are a good many people who would be very glad indeed to hear that he had decided to come back to school, and it is to be hoped that he will.

In a game played on the evening of Monday, Feb. 11, the Rose basket ball team outplayed the Y. M. C. A. team at the Poly gymnasium. The score was close, being 18–17 in the Poly's favor. The success of the team in this game will help, in a large measure, to heal the wounds of the first contest. A full account of the game must be deferred till the next issue of THE TECHNIC.

The following lines were found written on the the back of the examination paper of a somewhat discouraged "examinee." It is pleasant to learn that he passed :

"Adieu, thou hopes of engineering glory,
It's all my fault. The same old story :
Girls, foot ball, theater parties—pleasures all.
Once started, how easy 'tis to roll the ball.

"Now, come on, you hod or shovel, hoe or pick.
Faugh, such thoughts should make a Poly sick.
Well, the bed is made ; may I have the grace
To leave the dear old school, a smile upon my face."

Prof. Howe is investigating the possibility of securing, for the use of the Civils what would be a serviceable acquisition for the course. This is a series of lantern slides, representing the different varieties of woods, with the structure enlarged sufficiently so that the distinctive characteristics may be evident. This would especially be of use in the case of woods of nearly the same kind, which, while they are difficult to distinguish by ordinary inspection, show characteristic differences of structure at a slight magnification.

The principal excitements of the closing days of January were frequent skirmishes between the Freshmen and Sophomores, caused by false reports of the Sophomore banquet. On one occasion the President of the Freshmen found an invitation to the banquet on the letter-board. It was learned afterward that it was the work of a meddler, and that its sole object was to cause a little excitement. As a result of this supposed information, the Freshmen immediately captured several of their rivals, and it was not until both classes had cut school to go upon the war-path that a truce was agreed upon.

Prof. Hathaway has been a busy man recently, as is evidenced by the number of articles by him that are being published. The January Physical Review contains two book-reviews from his pen,-one on "Scientific Papers", by P. G. Tait, the other on the "Theory of Screws" published by Sir R. S. Ball. At the recent meeting of the American Mathematical Society, at Chicago, he read two papers, "The Higher Mathematics for Engineering Students" and "Quaternions and Fourfold Space". The latter paper will appear shortly in the Proceedings of the Society. Prof. Hathaway's Calculus, which is being published by Moore & Langen, in Terre Haute, is now about half in type.

AT THE SOPHOMORE BANQUET.

Shrceder—"Three cheers for naughty three."

Nicholson '02 calls the "split spoon" a "pitchfork."

"Pettit should give up engineering and study oratory."

Braman, at intervals—"That story reminds me," etc.

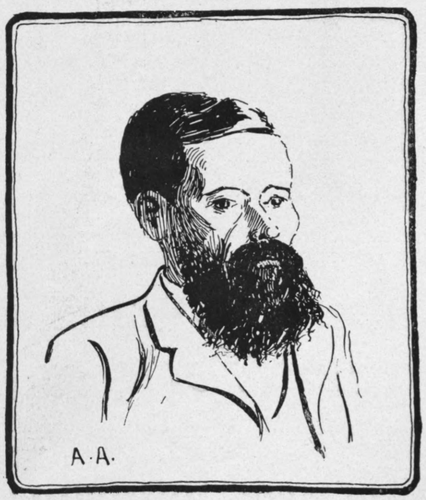
Oglesby says he can tie up five Freshmen dead easy. A pause after the dead.

Oglesby—"I have made a bull somewhere. I have to eat my cream with this split spoon."

Someone suggested that no "shop talk" be allowed, whereupon Rumbley objected, as he wanted to talk of "Books."

Consomme should be served in soup plates to avoid embarrassing mistakes. Kellogg said he didn't drink coffee, and Kirby asked for cream.

TECHNIGRAPHS, V.



ONE OF THE NOBILITY.

SCIENTIFIC SUPPLEMENTS TO THE ROSE TECHNIC—II.

INTERNATIONAL ATOMIC WEIGHTS.

[Translated from report of the Committee on Atomic Weights, Deutsche Chemische Gesellschaft, 1901.]

ELEMENT.	Symbol.	O=16.0 H=1.008	H=1.00 O=15.88	ELEMENT.	Symbol.	O=16.0 H=1.008	H=1 00 O=15.88
Aluminum	Al	27.1	26.9	Neodymium	Nd	143.6	142.5
Antimony	Sb	120.	119.1	Neon	Ne	20.	19.9
Argon	A	39.9	39.6	Nickel	Ni	58.7	58.3
Arsenic	As	75.0	74.4	Niobium	Nb	94.	93.3
Barium	Ba	137.4	136.4	Nitrogen	N	14.04	13.93
Bismuth	Bi	208.5	206.9	Osmium	Os	191.	189.6
Boron	B	11.	10.9	Oxygen	O	16.00	15.88
Bromine	Br	79.96	79.36	Palladium	Pd	106.	105.2
Cadmium	Cd	112.4	111.6	Phosphorus	P	31.0	30.77
Caesium	Cs	133.	132.	Platinum	Pt	194.8	193.3
Calcium	Ca	40.	39.7	Potassium	K	39.15	38.86
Carbon	C	12.00	11.91	Praseodymium	Pr	140.5	139.4
Cerium	Ce	140.	139.	Rhodium	Rh	103.0	102.2
Chlorine	Cl	35.45	35.18	Rubidium	Rb	85.4	84.76
Chromium	Cr	52.1	51.7	Ruthenium	Ru	101.7	100.9
Cobalt	Co	59.0	58.56	Samarium	Sa	150.	148.9
Copper	Cu	63.6	63.1	Scandium	Sc	44.1	43.8
Erbium	Er	166.	164.8	Selenium	Se	79.1	78.5
Fluorine	F	19.	18.9	Silicon	Si	28.4	28.2
Gadolinium	Gd	156	155.	Silver	Ag	107.93	107.12
Gallium	Ga	70.	69.5	Sodium	Na	23.05	22.88
Germanium	Ge	72.	71.5	Strontium	Sr	87.6	86.94
Glucinum	Gl	9.1	9.03	Sulphur	S	32.06	31.83
Gold	Au	197.2	195.7	Tantalum	Ta	183.	181.6
Helium	He	4.	4.	Tellurium	Te	127.	126.
Hydrogen	H	1.01	1.00	Thallium	Tl	204.1	202.6
Indium	In	114.	113.1	Thorium	Th	232.5	230.8
Iodine	I	126.85	125.90	Thulium	Tu	171.	170.
Iridium	Ir	193.0	191.5	Tin	Sn	118.5	117.6
Iron	Fe	56.	55.6	Titanium	Ti	48.1	47.7
Krypton	Kr	81.8	81.2	Tungsten	W	184.	182.6
Lanthanum	La	138.	137.	Uranium	U	239.5	237.7
Lead	Pb	206.9	205.35	Vanadium	V	51.2	50.8
Lithium	Li	7.03	6.98	Xenon	X	128.	127.
Magnesium	Mg	24.36	24.18	Ytterbium	Yb	173.	172.
Manganese	Mn	55.0	54.6	Yttrium	Y	89.	88.3
Mercury	Hg	200.3	198.8	Zinc	Zn	65.4	64.9
Molybdenum	Mo	96.0	95.3	Zirconium	Zr	90.7	90.0